Low Cost Solution to Retain More Larval Fish: Effectiveness of Using a Fine Mesh Screening on the Holding Tanks

Investigators

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Summary

The Central Valley Project's Tracy Fish Collection Facility (TFCF), located upstream of the Jones Pumping Plant (JPP) in the southern portion of the Sacramento-San Joaquin Delta (Delta), is owned and operated by the Bureau of Reclamation (Reclamation). TFCF Fish Diversion Workers (operators) collect fish (salvage) and transport them away from the influence of the pumps. Fish that enter the TFCF have to go through a series of louvers and bypasses before being concentrated into a holding tank. The holding tank screen has a mesh size opening as small as 0.1 in (2.54 mm), the size allowable to retain small fish (USBR 1956, Bates *et al.* 1960). However, in preliminary findings, Wu (2011, personal communication) demonstrated that small fish like 20-mm juvenile delta smelt (*Hypomesus transpacificus*) are not always retained by the holding tank screen (~25% loss, unpublished data).

The holding tank mesh size, selected in the early 1950s, was the smallest screen size shown to operate successfully most of the year and not clog with peat fibers (USBR 1956). With the invention of light weight, flexible, nylon Nitex screen, it is now possible to change the mesh size of the holding tanks quickly and inexpensively. In 2000 and 2008, short-term pilot studies were completed that looked at the possibility of wrapping a fine-mesh flexible screen around the existing holding tank's screen in spring when debris loads are at their lowest levels and when larval fish are present (debris load is highest in fall/early winter; Karp and Lyons 2008). In 2000 and 2008, a 1000- and 500-µm mesh screen was used, respectively. Installation or removal of the screen required less than 10 min and both net sizes were able to fish for 24 h without clogging. Samples were collected in April and June 2009; however, data are yet to be analyzed. The goal of this study is to determine if the Nitex screen is durable enough to be incorporated into the normal salvage operations at the TFCF and if this material will result in a greater number of living larval and juvenile fish being loaded into the fish-haul truck for release back to the Delta.

Problem Statement

Larval fish are lost through the holding tank screen during fish salvage collections (Wu 2011, personal communication). A temporary blanket of 500-µm Nitex screen was used over the existing holding tank screen because it has shown promise for short-term use. By using a 500-µm Nitex screen instead of 1000 µm, we are assuming that smaller larval/juvenile fishes will be retained by using the smaller mesh. Successful Nitex screen retention of larval and juvenile fishes, especially delta smelt and longfin smelt (*Spirinchus thaleichthys*), will mean enhanced salvage and more fishes released to the Delta.

Goals and Hypotheses

Goals:

1. Determine if the number of swimming larvae in the haul-out bucket is significantly different between the holding tanks with and without the Nitex screen.

2. Determine how long a 500-µm Nitex screen can be used in a holding tank before it fails (*i.e.*, rips, clogs, rolls down)

Hypotheses:

1. The holding tank with Nitex screen will positively affect the number and the length of swimming larvae retained.

2. The properly installed and durable Nitex screen can be left in a holding tank for a period of 4 weeks before it fails.

Materials and Methods

A 500-µm Nitex screen is installed by wrapping it around the holding tank screen and overlapping the ends so that waterflow keeps the screen impinged against the holding tank screen. Three ropes encircle the screen and are attached with bungee cords along the top, middle, and bottom of the screen. In addition to the Nitex screen around the holding tank, Nitex screen is also installed on the 2.5-mm perforated haul-out bucket (1703 L).

To get a paired sample, one holding tank will have a Nitex screen and another will have none. Sampling will begin in the evening (after the evening haul-out, ~11 AM) and completed the following morning (before the morning haul out, ~7 AM). Sample period, therefore, is about 8 h. In order to collect paired samples, both holding tanks will be turned on at the same time making sure the velocity and the volume of water are the same going into each holding tank. At the conclusion of each sample period, both holding tanks will be turned off at the same time and drained simultaneously by a Fish Diversion Operator in preparation for removing the fish to the haul-out truck. The sampler (a biologist) will document the type (peat, woody, Egeria) and approximate amount (low, average, or heavy) of debris in the sample. The sampler will take a fish sample from the haul-out bucket once it is lifted up to waist level. Three 18.9-L black buckets will be used to take a subsample of the swimming larvae/juveniles in the haul-out bucket. This will be completed by quickly submerging the entire bucket and quickly removing it.

Because the first subsample will likely affect the following two subsamples, it is important to collect the samples from different points of the haul-out bucket. The haul-out bucket has a wide enough water surface area to allow at least three different points of sampling. Because we are sub-sampling for swimming larvae/juveniles with this technique, bottom-oriented larvae and dead larvae that should sink to the bottom are not sampled. Before the next sample period, the Nitex screen is removed and installed in the holding tank that did not have the Nitex screen. This is done to in order to minimize tank effect.

After the paired sampling period, the Nitex screen can be used for longer duration testing. The purpose of this testing is to see if the material can withstand continual use. The Nitex screen will be installed on holding tank 3 or 4 and operated and cleaned under normal operating conditions. The waterflow through the screen, tank depth, debris types entering the tanks (peat, wood, or Egeria), and screen differential will be monitored daily until screen failure (clogged or ripped). A clogged screen will be defined as a clearly visible differential (~100 mm) over the face of the screen. Once the screen is clogged, it must be cleaned with a high pressure utility hose and then put back into operation. The rate of clogging will be documented. Once a screen has been in place for 2 weeks, it will be washed and bleached (5% sodium hypochlorite for 10 min) and air dried to kill the biofouling microorganisms. The cleaning of the Nitex screen is best done in place, but can also be completed once it is removed. If it is cleaned in place, the chorine will be neutralized with sodium thiosulfate before releasing it back to the Delta. The purpose of continually using the Nitex screen is to determine how long it lasts when used in production mode and if the cleaning process restores it back to the original condition.

Data Analysis and Interpretation

Statistical tests for paired sampling procedures will be used to evaluate the samples. The number of swimming fish from the haul-out buckets will be used to assess the effectiveness of two treatments (Nitex screen vs. no screen).

For this sampling program it is assumed that the flow rates passing through the two tanks are nearly equivalent. If the total measured flow between the two tanks is off by more than 20% for any paired sample, that sample must be discarded. This experiment is trying to show there are differences in collection efficiency >50% between the treatments and inequity in holding tank flows should not interfere with the results.

Paired holding tanks samples will be used to determine if there is an association between holding tank screen size and the number of delta smelt and other species collected. In addition, the association between screen size and size class of smelt (11–15, 16–20, 21–25 mm TL) collected will be investigated. A chi-squared goodness of fit test will be used to make these comparisons. If a significant difference is detected, the percent change from the normal condition (no Nitex screen) will be calculated.

Paired samples were collected from April 1–June 10, 2009. Only one more paired sample is left to be sorted and measured. Due to other Biological Opinion commitments, work for this project was postponed this past season. Data still need to be entered into a spreadsheet and sent to a statistician. Data will be analyzed in 2012–2013. If data show inconclusive, a few more paired samples will be collected in 2012–2013 during presence of high number of fish larvae between April and July.

Coordination and Collaboration

The study will be coordinated with the TFCF biology staff, TFCF Fish Diversion Crew (Joel Imai), and TFCF management (Ronald G. Silva). René Reyes is the principal investigator for this project and will direct activities. René will coordinate with the onsite operators, write a job hazard analysis, and obtain permits for this work. Brent Bridges and Brandon Wu will assist René with screen installation, cleaning, and purchasing. This project cannot be completed unless the operators are willing to help collect the samples and fix/remove the net in the event that it fails. In addition, this project cannot be completed unless the flowmeters are working for both tanks 3 and 4.

Endangered Species Concerns

Delta smelt are currently being petitioned to be placed on the endangered species list. The sampling program for this project is scheduled to coincide with the larval/juvenile delta smelt season and therefore we will potentially take this species. The intention of this project is to find a way to improve the salvage operations for delta smelt larvae/juveniles so that more of them are released back to the Delta. In addition, during our sampling we are likely to take winter run salmon (*Oncorhynchus tshawytscha*). California Department of Fish and Game (CDFG), and National Marine Fisheries Service will be given a copy of our proposal for consideration. The biological opinion written by the U.S. Fish and Wildlife Service already grants us permission for completing this type of study to help increase salvage operations. Any ESA listed species collected from the 18.9-L bucket samples will be measured and counted. Adult delta smelt or juvenile salmon collected in this sample will be returned back to the Delta. All larval/juvenile delta smelt in the 18.9-L sample will be preserved. Take for this project will be reported daily to CDFG and take will consist of fish collected in our 18.9-L sample and not in the entire holding tank. We anticipate that with ten paired samples it would be possible to capture up to 10,000 larval/juvenile delta smelt.

Dissemination of Results (Deliverables and Outcomes)

The primary deliverable will be an article published in the Tracy Volume Series. Technical updates will be provided at Tracy Technical Advisory Team meetings.

Literature Cited

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